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Skill profiles of training occupations and occupational segmentation of vocational education and training in Germany

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ABSTRACT

Vocational education and training (VET) is crucial for labour market integration and ensuring a skilled workforce. However, VET systems, particularly in countries like Germany and Switzerland, offer heterogeneous training occupations with different labour market returns. This study examines occupational segmentation within VET, applying labour market segmentation theories to identify structural differences in skill profiles, training commitment, gratification and social access based on school-leaving certificates. Utilising the German VET system as a case study, we analyse data from 338 dual and school-based training occupations. We employ latent profile analysis to classify training occupations into skill profiles according to their firm-specific and occupation-specific skills, as well as their cognitive requirement level. The analyses reveal four distinct skill profiles that are systematically associated with training commitment, gratifications and social access based on school-leaving certificates. The results suggest that VET is stratified into occupational training segments, offering training at varying skill levels. These segments exhibit unequal training conditions, with some providing significantly higher commitment or higher gratifications. This research provides a more nuanced understanding of VET segmentation than the distinction into dual and school-based trainings, offering valuable insights for political actors and institutions involved in VET, as well as training firms and vocational schools.

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Introduction

Vocational education and training (VET) plays an integral role in the qualification and labour market integration of individuals. However, VET is not homogeneous, but consists of various training occupations that exhibit notable differences in subsequent labour market prospects (Haupt and Ebner 2020). This is particularly evident in countries like

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Germany or Switzerland with large VET sectors and 'occupational labour markets' (DiPrete 2002; Marsden 1990).

Thus, VET researchers investigate the stratification along these heterogeneous training occupations (Achatz, Jahn, and Schels 2022; Dummert 2021). Several studies argue that the training system itself is internally segmented (Baethge 2010; Hall 2021; Protsch and Solga 2016), and that the differences in labour market outcomes could partly be linked to structural differences between training occupations (Eggenberger, Rinawi, and Backes-Gellner 2018; Geel and Backes-Gellner 2011; Menze 2017). Yet, most research devoted to the segmentation of VET fails to include school-based training occupations, thereby overlooking a prominent part of the heterogeneity of the system.

Labour market segmentation theories (Doeringer and Piore 1985; Lutz and Sengenberger 1974) provide a useful theoretical framework to study the occupational segmentation of VET. So far, no study has transferred this framework to the occupational segmentation of VET by analysing structural differences in skills, training commitment, gratifications and social access to training occupations based on school-leaving certificates. Identifying the skill profiles of training occupations to measure structural differences in human capital is fundamental for applying segmentation approaches to VET. Prior research has shown that training occupations encompass varying degrees of occupational specificity and firm specificity (Eggenberger, Rinawi, and Backes-Gellner 2018; Jansen, de Grip, and Kriechel 2017; Menze 2017; Mueller and Schweri 2015) as well as cognitive requirements (Friedrich, Rohrbach-Schmidt, and Sander 2023; Stalder 2011). Nevertheless, to the best of our knowledge, no study has yet analysed and systematised the skill bundles of training occupations with regard to these three skill dimensions.

In light of these research gaps, the aim of the study is to develop a conceptual framework for the occupational segmentation of VET, to explore this framework empirically and to describe the occupational training segments. More precisely, we investigate the skill profiles of training occupations in relation to training commitment, gratifications during training and how accessible training is based on school-leaving certificates in these occupations. We pose two research questions: First, which skill profiles do the training occupations exhibit concerning occupational specificity, firm specificity and cognitive requirements? And second, do these skill profiles indicate occupational training segments with distinct patterns of training commitment, gratifications and social access based on school-leaving certificates?

To examine these questions, we use the German VET system as a case study. In Germany, skills imparted in training occupations are standardised through binding curricula specifying the training duration, the required skills and knowledge, and the examination criteria. This standardisation ensures that all trainees learn the same skills, regardless of their training region, firm or school. Thus, VET skills can be examined particularly well in Germany.

We use a newly developed dataset of 338 dual and school-based training occupations registered in 2019, which covers the majority of all fully-qualifying VET occupations in Germany.¹ Using latent profile analyses, our results show four occupational clusters with distinct skill profiles. Mean value comparisons suggest that these skill profiles also differ in terms of their typical training commitments, gratifications and social access based on school-leaving certificates, thus indicating the existence of four occupational training segments.

The study makes three contributions to the literature: First, our study covers both the dual and school-based occupations and thus studies the segmentation of the entire VET system in Germany. Previous research has focused on dual-training occupations (e.g. Protsch and Solga 2016), or used broad distinctions between the dual and the school-based system (Weitz and Ludwig-Mayerhofer 2024). However, the school-based occupations are of sizeable importance in Germany and should not be neglected. Second, the study suggests a segmentation theoretical framework that describes four segmentation characteristics for VET: skills, training commitment, gratifications and social access to training based on school-leaving certificates. Third, the study analyses how training occupations are clustered into similar skill profiles of different occupational specificity, firm specificity and cognitive requirements. Previous research has not yet analysed the combination of these skill dimensions nor their relevance for segmentation.

From a policy perspective, this research creates valuable insights for political actors and institutions involved in VET as well as for firms and vocational schools offering training. The study is structured as follows: we provide an overview of the German VET system, before developing the conceptual framework for the occupational segmentation of VET. Following, we discuss the differences between training occupations in skills, training commitment, gratifications and social access based on school-leaving certificates, before describing the research design. Finally, we present the results and discuss the findings and research and policy implications.

The German VET system

The German VET system is divided into three subsystems: the dual system, the school-based full-time vocational system, who both lead to a full vocational qualification, and a prevocational transition system, in which young people can upgrade their school certificates or attain partial vocational qualification (Solga et al. 2014). We focus on the fully qualifying training occupations of the dual and school-based vocational training system. In recent years, about 700,000 young people entered the VET system annually and it is the largest education sector in Germany (Bundesinstitut für Berufsbildung 2024, 17). The training enrolment in the school-based system accounts for one third of the total VET system, and training numbers have grown steadily until 2020 especially in the health and care occupations (17). Unlike VET systems in some other countries, fully-qualifying dual and school-based VET do not provide alternative pathways for the same occupation but train for different occupations² (Solga et al. 2014).

In 2019, the dual system registered 326 training occupations with a training duration of two to 3,5 years, mainly in manufacturing and industry as well as craft and trade (Bundesinstitut für Berufsbildung 2019). A strong focus on experience-based learning characterises dual training. Training firms serve as the primary learning venue and provide practical training (3–4 days a week) (Pilz and Fürstenau 2019). Theoretical and practical instructions in vocational schools (1–2 days per week) complement the work-place oriented learning (Pilz and Fürstenau 2019). Trainees receive nationally recognised certificates. The training regulations, including curricula, are governed by a collective of the federal government, employer associations, trade unions and practitioners (Lorig, Stöhr, and Schwarz 2017). Due to the high involvement of employers in both curriculum setting and providing training, the labour market relevance of the trained skills is high (Thelen

and Busemeyer 2012). Access to the dual system is not formally restricted to a specific school-leaving certificate but is market-driven, as young people apply for apprenticeships offered by training firms (Protsch and Dieckhoff 2011) who act as gatekeepers (Kohlrausch 2012).

The school-based training occupations are part of full-time VET and mainly cover training occupations in health, education and the social sector with a training duration of 2 to 4 years (Bundesinstitut für Berufsbildung 2024, 19; Deißinger 2018). In contrast to the dual system, the vocational school is the main learning venue in school-based VET. Some school-based training occupations foresee practical phases in training firms where trainees apply and deepen their knowledge in the work-place. Especially the health and care occupations exhibit high shares of work-place oriented learning that resemble the dual-learning environment (Deißinger 2018). Contrary to the dual system's high level of institutional stakeholder collaboration the school-based training occupations are regulated and revised by federal or state laws. Access to school-based training often formally requires an intermediate or even higher school-leaving certificate and the availability of training positions depends on federal or state-level resources for vocational school teachers, and the supply of firm-based internships or training places (Solga et al. 2014).

Occupational segmentation of VET

Conceptual framework

The German VET system is stratified along heterogeneous training occupations that impart different types of skills and are related to different labour market returns (Geel and Backes-Gellner 2011; Langer and Wiederhold 2023). The observed heterogeneity has prompted researchers to investigate these disparities (Achatz, Jahn, and Schels 2022), and some argue that the VET system itself is internally segmented (Baethge 2010; Hall 2021; Protsch 2014). Prior research links the differences in labour market returns to structural differences between training occupations (Eggenberger, Rinawi, and Backes-Gellner 2018; Geel and Backes-Gellner 2011; Menze 2017).

Training segments are often defined by the typical composition of trainees – especially with regard to their prior school education (Hall 2021; Baethge 2010; Protsch 2014). Other approaches divide VET into institutional segments of dual and school-based training occupations (Weitz and Ludwig-Mayerhofer 2024) or use industry-specific training strategies to derive the opportunities for training-appropriate employment (Büchel and Neubäumer 2001). Overall, most research focuses on dual-training occupations and does not consider school-based training occupations, even though they make up a substantial share of total VET in Germany. Furthermore, no study has employed a segmentation theoretical approach nor directly addressed differences in skills to identify training segments.

For our conceptual framework, we draw on the segmentation theories that have been developed for the labour market (Doeringer and Piore 1985; for Germany: Lutz and Sengenberger 1974; Blossfeld and Mayer 1988). These theories state that the labour market is not a single homogeneous market but is divided into segments with unequal labour market conditions. The segments differ in the required type of human capital (i.e. general, occupation-specific or firm-specific human capital (Acemoglu and Pischke 1999;

Becker 1964; Nawakitphaitoon 2014)). The differences in human capital requirements are associated with different types of commitment between employers and employees (Sengenberger 1987, 48) and are linked to typical gratifications (e.g. low versus high average wages and risks of unemployment). The differences in human capital requirements finally also shape allocation processes assigning employees to jobs in the segments.

For Germany, Lutz and Sengenberger (1974) conceptualise three ideal typical labour market segments: an unspecific segment, a vocational segment and an internal segment. The unspecific segment, which does not require any specific human capital, is characterised by a low commitment between employer and employees, thus high fluctuation and more precarious employment conditions. This segment gathers employees with a lower expected productivity that employers were not willing to invest in. The vocational segment requires occupation- or sector-specific skills. Low occupational or sector mobility, caused by high transaction costs, characterises employment in this segment. Gratifications are higher than in the unspecific segment and likely shaped by collective bargaining agreements. Typically, vocationally qualified individuals with the relevant job-specific certificates have access to this segment. The internal segment requires firm-specific skills and exhibits a strong commitment between employers and employees. Cross-firm mobility is restrained through high transaction costs. This segment offers good internal promotion and pay opportunities for vocationally or academically qualified employees.

Transferring the theoretical assumptions of labour market segmentation directly to the VET context is not possible, as labour market and vocational training institutions clearly differ in their purpose (employment vs. qualification), the involved actors (employees vs. trainees) and the institutional regulation (employment contracts vs. training contracts). Nonetheless, as we argue in the following section, the core idea of segments with different human capital requirements associated with commitment, gratifications and social access can be derived and applied to VET.

Differences between training occupations in segmentation characteristics

Differences in skills

Literature conceptualises training occupations as skill bundles, imparting diverse competencies to trainees (Haupt and Ebner 2020). VET in different occupations trains for horizontally different occupational tasks and provides different skills, such as manual, cognitive, social or digital skills (Langer and Wiederhold 2023).

Research often understands VET as mainly teaching occupation-specific skills (McNally, Ventura, and Virtanen 2020). However, recent research shows that the skills imparted in training occupations vary in the degree of occupational specificity, with some trainings (e.g. clerks) imparting less specific or general skills (Eggenberger, Rinawi, and Backes-Gellner 2018; Grønning and Kriesi 2022; Menze 2017).

Further, training occupations also impart skills of varying degree of firm specificity. The different structural models of curricula allow training firms to customise training content based on firm-specific needs to varying degrees (Jansen, de Grip, and Kriechel 2017; Pilz 2012; Schweri, Aepli, and Kuhn 2021). For instance, training occupations with 'elective

qualifications' like media technologist in print processing allow for firm-specific differentiation of training content.

Finally, training occupations are not equally demanding regarding the level of skills to be learned. Studies for Switzerland and Germany show that training occupations confront trainees with different cognitive demands (Friedrich, Rohrbach-Schmidt, and Sander 2023; Hall 2021; Stalder 2011). For example, skilled workers in the hospitality industry have lower cognitive requirements and IT specialists have higher cognitive requirements.

Although numerous studies have shown the differences in the occupational specificity, firm specificity and cognitive requirements between training occupations, the combinations of these skill dimensions have not yet been investigated. To address this gap, we first analyse typical combinations of occupational specificity, firm specificity and cognitive requirements which we define as skill profiles. We then investigate the relationship of the skill profiles with commitment, gratifications and social access based on school-leaving certificates.

Differences in commitment, gratifications and social access based on school-leaving certificates and their associations with skill profiles

First, training firms pursue different training strategies, which are characterised by stronger or weaker commitment. The economics of education literature particularly discusses two strategies: the production-oriented and the investment-oriented strategy (Lindley 1975; Merrilees 1983). The production-oriented strategy implies that training firms provide training due to the productivity of trainees (e.g. by having trainees perform more skilled tasks). Firms following an investment-oriented strategy focus less on productive gains and train to invest in the optimal skills of their future skilled employees (e.g. by giving trainees more learning time). The more pronounced the investment strategy of training firms is, the greater their efforts should be to secure their investments by retaining trainees (Dionisius et al. 2009). The commitment is likely to be looser for a production-oriented strategy since both parties might have less interest in maintaining the training relationship. Research shows that training occupations differ in whether their training is more production-oriented or investment-oriented (Dionisius et al. 2009). With respect to skill profiles, we assume that training occupations with higher occupational specificity might be more production-oriented, as a high degree of occupational specificity could facilitate firm turnover after training. Thus, on average, skill profiles with higher occupational specificity should exhibit a higher prevalence of the production-oriented training strategy than skill profiles with lower occupational specificity (H1a). In contrast, training occupations with higher firm-specificity may make trainees more difficult to replace by hiring from the external labour market (Jansen, de Grip, and Kriechele 2017; Schweri, Aepli, and Kuhn 2021). In more cognitively demanding occupations, trainees might spend more time learning and less time working productively, making the investment in these skills costlier for firms during training. Firms can only amortise this investment if they take on the trainees after training (Schönfeld et al. 2020). Thus, on average, skill profiles with higher firm-specificity or higher cognitive requirements should exhibit a higher prevalence of the investment-oriented training strategy than skill profiles scoring low in these skill dimensions (H1b).

Second, training occupations afford varying degrees of monetary and non-monetary gratifications. Training occupations are associated with different training allowances

(Schönfeld and Wenzelmann 2021). In the dual system, trainees are legally entitled to an appropriate remuneration (Schönfeld and Wenzelmann 2021, 2), while some school-based occupations are not remunerated. From a human capital perspective, higher allowances can be seen as an immediate return to trainees' investment, which increase the attractiveness of acquiring specific skills that may limit labour market mobility after training (Vicari and Unger 2020). Paying higher allowances could also be a recruitment strategy to attract high-achieving trainees. Therefore, on average, skill profiles with higher occupational specificity or firm specificity or higher cognitive requirements should have higher allowances than skill profiles scoring low in these skill dimensions (H2a). Furthermore, training occupations exhibit different levels of occupational prestige (Ebner and Rohrbach-Schmidt 2021). The occupational prestige reflects the perceived 'symbolic' value of occupations. Research indicates that young people form their occupational aspirations with the intention of strengthening their social identity (Schels and Abraham 2023). As training in an occupation with higher occupational prestige could boost the social status of trainees, individuals may pursue high-prestige training occupations even when there is no immediate financial compensation (Kleinjans, Krassel, and Dukes 2017). Research has already shown that occupations with higher skill requirements are perceived as more prestigious (Abrassart and Wolter 2020). Thus, on average, skill profiles with higher cognitive requirements should exhibit a higher prestige than those with lower cognitive requirements (H2b).

Third, training occupations are not equally accessible for applicants with different school-leaving certificates. Especially individuals with lower school-leaving certificates are frequently excluded from certain training occupations, either as a result of institutional barriers or social processes (Protsch 2014; Protsch and Solga 2016). In the early career stage, school-leaving certificates constitute an important signal for productivity (Spence 1973). While, VET in school-based occupations often formally requires an intermediate or higher school-leaving certificate, training firms act as gatekeepers in dual-training occupations (Kohlrausch 2012). With regard to skill profiles, we expect that in training occupations with higher firm specificity, training firms might screen applicants more thoroughly based on school-leaving certificates to ensure their future investment. In addition, training institutions offering training occupations with higher cognitive requirements may also select applicants more rigorously based on school-leaving certificates to meet the requirements of the training. Thus, on average, in skill profiles with higher firm specificity or higher cognitive requirements, the share of trainees with higher school-leaving certificates should be higher than in skill profiles with lower firm specificity or lower cognitive requirements (H3).

Research design

Data

We use a new dataset created specifically for our analysis, which covers 338 training occupations and thus nearly all current training occupations in Germany. The variables were compiled from seven different data sources. Appendix A1 provides a brief description of these data sources and the variables extracted from them. Appendix A2 provides univariate statistics on the variables.

Our dataset includes 317 of the 326 dual-training occupations in 2019. We excluded nine dual-training occupations: eight without a valid training regulation in 2019 and the ship mechanic regulated by the Maritime Vocational Training Ordinance. In addition, we selected the 21 largest health and care occupations trained in vocational schools with more than 1,000 students in 2019/2020 (seven of which are regulated by state law and 14 by federal law). In 2019, these health and care occupations cover around 80% of all students in the school-based system (Bundesinstitut für Berufsbildung 2024).

Variables

To measure the *occupational specificity* of training occupations, we use an indicator from Vicari and Unger (2020) (see Appendix A1.1) that reflects the extent to which the competences required in the occupations are also required in other occupations. With an average of 0,7 on a scale of 0 to 1, training occupations in Germany are characterised by a high degree of occupational specificity (see Appendix A2).

Following Jansen, de Grip, and Kriechel (2017) we use the structural model to measure *firm specificity* of dual-training occupations. This structural model is derived from the Register of Recognised Training Occupations (see Appendix A1.2). The structural model distinguishes between four types of occupations: ‘mono-occupations’, ‘occupations with priority topics’, ‘occupations with disciplines’ and ‘occupations with elective qualifications’. Mono-occupations allow the least flexibility, their training content is prescribed for all firms (Schwarz et al. 2015). In contrast, occupations with ‘priority topics,’ ‘disciplines,’ or ‘elective qualifications’, in that order, facilitate an increase in the firm-specific differentiation of training content (Euler and Frank 2011; Schwarz et al. 2015). As training curricula for school-based training occupations do not enable firm-specific differentiation, we classify them as mono-occupations. In Germany, most training occupations are structured as mono-occupations (227 of 338, see Appendix A2).

To measure the *cognitive requirement level* of training occupations, we use an indicator of the Vocational Psychological Service (BPS) of the Federal Employment Agency (see Appendix A1.3), which reflects ‘the level of cognitive skills required to successfully learn and practice an occupation’ (Friedrich, Rohrbach-Schmidt, and Sander 2023, 16). The indicator has five levels from ‘slightly below average’ (3) to ‘slightly above average’ (7). The mean average of the training occupations in Germany is 4.8, which is indicative of an average level of cognitive requirements (see Appendix A2).

As discussed, we specify the concept of *commitment* between the training firms and the trainees using the training strategy of firms. These strategies can only be measured for dual-training occupations as we draw upon a direct collection of these strategies from the BIBB-Cost-Benefit-Survey 2017/18 (Wenzelmann et al. 2021; see Appendix A1.4). Training firms were directly asked about the importance of ‘deploying trainees as employees while they are still in training’ (production-oriented) and ‘training skilled employees with a view to retaining them in the firm in the long term’ (investment-oriented) as reasons for training. Firms rated the importance of both strategies separately. We aggregate the firms’ assessments on these response categories for both strategies at the occupation level. Across the 317 dual-training occupations in 91.8% training occupations the investment-strategy is rated as important, in 22.1% the production-strategy is important. Overall in 16.2% of training occupations, both production- and investment-strategy were rated as important (see Appendix A2).

Monetary gratifications of training occupations are captured by monthly *training allowances*. For the dual-training occupations, we use the agreed training allowance in the training contract as reported in the vocational training statistics (Uhly 2022; see Appendix A1.5). For the school-based training occupations, we derive the monthly allowances from collective agreements. Training occupations offer a monthly allowance of 814 Euros on average. For training occupations without federal collective agreement or contract data, we assume that no allowance is paid. This mostly concerns the state-regulated school-based training occupations. The allowances range from 0 to 1,166 Euros per month (see Appendix A2).

We use the indicator for *occupational prestige* from the BIBB survey on the prestige of occupations in Germany to measure non-monetary gratification (Ebner and Rohrbach-Schmidt 2021) (see Appendix A1.6). Across all training occupations, the average prestige is 5.5 on a scale of 11 possible prestige points (see Appendix A2).

To operationalise social access based on school-leaving certificates, we use the *educational composition* of trainees within training occupations (see Appendix A1.5 and A1.7) distinguishing between new trainees with a lower school-leaving certificate, with an intermediate school-leaving certificate and with a higher school-leaving certificate.³ On average, training is taken up by trainees with intermediate school-leaving certificates (39.5%), followed by trainees with higher school-leaving certificates (32.5%), and trainees with lower school-leaving certificates (23.1%) (see Appendix A2).

Analytical approach

Our analytical approach consists of two steps. First, to answer our first research question on which skill profiles the training occupations exhibit, we employ latent profile analysis (Spurk et al. 2020; Weller, Bowen, and Faubert 2020). This method is suitable because it allows to identify latent categories or profiles in which observations group based on similar patterns of indicator variables (in our case 338 training occupations along three skill variables) (Spurk et al. 2020). We include z-standardised measures of occupational specificity, firm specificity and the cognitive requirement level as quasi-metric variables in our latent profile analysis. To determine the number of skill profiles, we start with a model solution for a single profile that is extended by additional profile splits until a model solution with the best model-fit values for the Akaike and Bayesian information criteria is achieved (Weller, Bowen, and Faubert 2020). Once the number of modelled profiles is established, the membership probability of each training occupation for each identified skill profile is calculated. In the subsequent analyses, modal affiliation is employed, whereby each training occupation is assigned to the skill profile with the highest probability of affiliation. We then describe the skill profiles and their typical characteristics and examine how many and which occupations they contain.

In the second step, and to answer our second research question, we investigate whether typical patterns of training commitment, gratifications and social access based on school-leaving certificates exist in these skill profiles. To this end, we compare the means of the segmentation variables across skill profiles and test for statistically significant differences using Kruskal – Wallis tests, followed by Dunn’s post-hoc tests with Bonferroni correction (Dinno 2015; Dunn 1964), which are particularly appropriate for identifying differences across multiple subgroups.

Results

Skill profiles in VET

The results of the latent profile analysis support the assumption of multiple, distinct skill profiles within the German VET system. Specifically, the information criteria indicate four profiles as best model solution (see Appendix A3, Table A3). Figure 1 illustrates the four profiles based on their characteristics on the three skill variables relative to the average of all 338 training occupations. Each skill profile is defined by distinct combinations of occupational specificity and firm specificity, and cognitive requirements. An overview of the unstandardised values on the skill variables across profiles is depicted in Appendix A4, Table A4.

Profile 1 exhibits above average level of occupational specificity (0.8), limited opportunities for conveying firm-specific skills (88.5% trainings are mono-occupations) and low to medium cognitive requirements (4.3). We refer to Profile 1 as the Occupation-Specific-Low-Cognitive (OS-LC) Profile.

Profile 2 is also characterised by an above average degree of occupational specificity (0.8) and below average firm specificity (81,8% are mono-occupations). Contrary to the OS-LC Profile, the second profile is characterised by high cognitive requirements (6.2). We thus refer to Profile 2 as the Occupation-Specific-High-Cognitive (OS-HC) Profile.

Profile 3 displays typical levels of both occupational specificity (0.7) and cognitive requirements (4.9). It is particularly characterised by high firm specificity, as all of the training occupations in this profile have either disciplines (67.1% of occupations) or elective qualification units (32.9% of occupations). We refer to Profile 3 as the Firm-Specific (FS) Profile.

Profile 4 differs the most from the average of all training occupations. With an occupational specificity of 0.4 and 97.4% of occupations structured as mono-

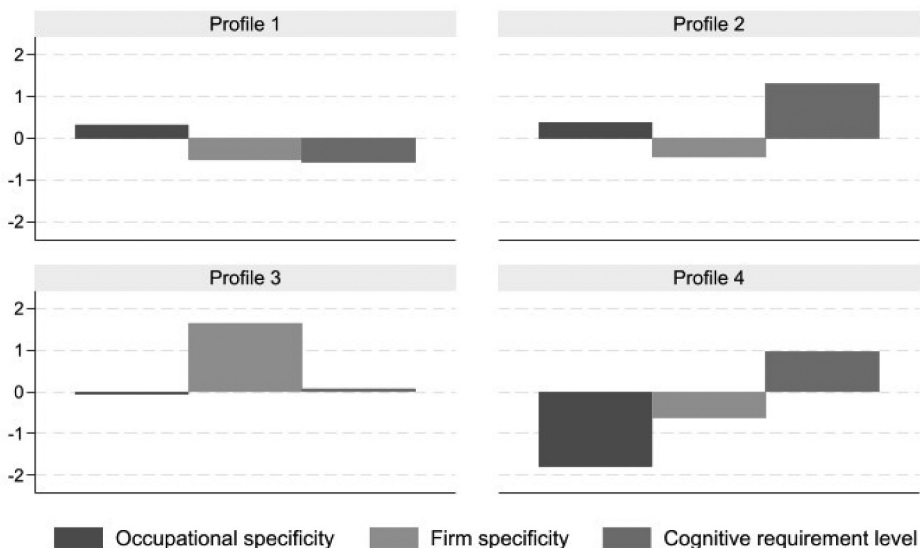


Figure 1. Average deviation of profiles in skill variables compared to overall mean.

Note: means of z-standardised skill variables in the four skill profiles.

Source: data set of 338 training occupations.

Table 1. Description of skill profiles and clustered training occupations.

Name	Description of skill profile	Number of training occupations	New trainees in 2019	Examples for training occupations
OS-LC	Higher occupational specificity, lower firm specificity, lower level of cognitive requirements	174	338,192 (49.2%)	Building cleaner, Scaffolding worker; Geriatric nurse, and Masseur and medical lifeguard
OS-HC	Higher occupational specificity, lower firm specificity, higher level of cognitive requirements	44	87,983 (12.8%)	Mathematic-technical software engineer, Informatics salespeople, Surgical assistant and Nursery caretaker
FS	Medium occupational specificity, higher firm specificity, medium level of cognitive requirements	82 (dual only)	193,480 (28.1%)	Salespeople, Woodworking mechanic, Beautician, and Media designers in image and sound
HC	Low occupational specificity, lower firm specificity, higher level of cognitive requirements	38 (dual only)	68,281 (9.9%)	Industrial clerk, Bank clerk, Dental technician, Production technologist

Source: Data set on 338 training occupations.

occupations, it is the most general skill profile. Regarding the level of skills, this profile is characterised by high cognitive requirements (5.8). We thus refer to Profile 4 as the High-Cognitive (HC) Profile.

The profiles differ significantly in their size as Table 1 illustrates. The OS-LC Profile is the largest profile including more than half of the training occupations (174) and about 49.2% new trainees in 2019. Examples of training occupations in this profile are Building cleaner and Geriatric nurse.

The OS-HC Profile contains 44 training occupations and 12.8% new trainees. Training occupations in this profile include Mathematic-technical software engineer and Surgical assistant.

The FS Profile is the second largest profile clustering 82 dual-training occupations and accounting for 28.1% new trainees. Examples of trainings in this profile include Salespeople and Media designers in image and sound.

Finally, the HC Profile is the smallest profile, with only 38 training occupations and 9.9% of new trainees. The profile exclusively encompasses dual-training occupations, such as Industrial clerk and Bank clerk.

Skill profiles and commitment, gratifications and social access based on school-leaving certificates

Following a segmentation theoretical framework, we further ask whether the identified skill profiles show systematic associations with training commitment, gratifications and social access based on school-leaving certificates. Figure 2 illustrates the means of the four skill profiles in terms of production-oriented vs. investment-oriented strategy (training commitment), monthly allowances and occupational prestige (gratifications) and the share of trainees with lower to higher school-leaving certificates (social access based on school-leaving certificates). The radar charts show the profile means on each standardised segmentation variable for each skill profile. The scales depict the minimum and maximum of the profile-grouped mean values for each variable. For an overview of profile means in all segmentation variables view Appendix A4, Table A4.

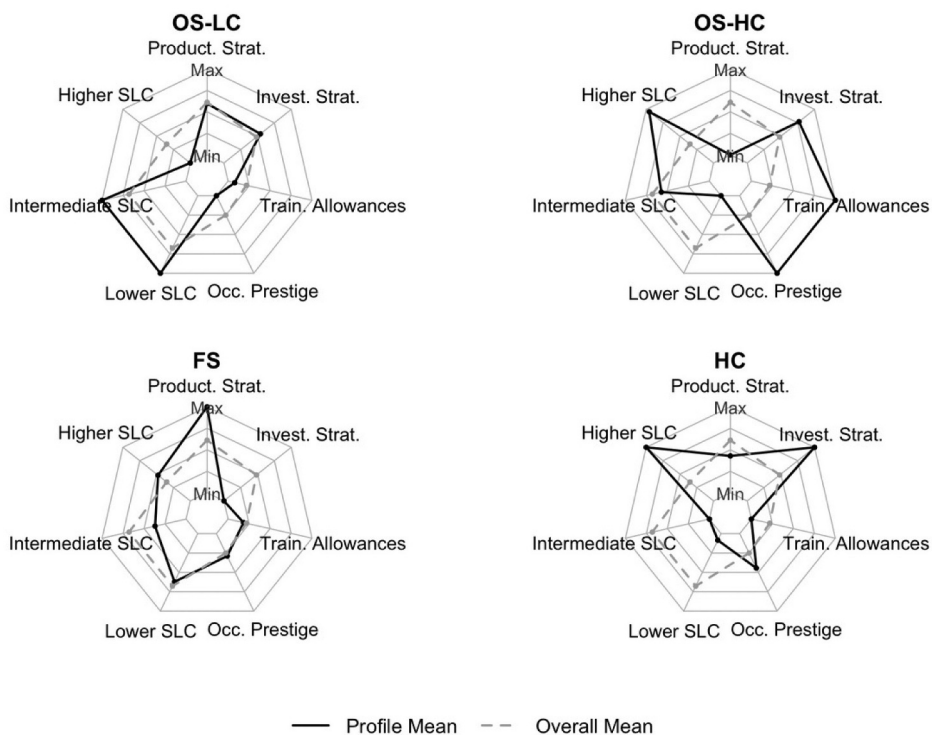


Figure 2. Skill profile means in commitment, gratification and access based on school-leaving certificates.

Note: The radar charts show the profile means on each standardised segmentation variable. The scales depict the minimal and maximal values of the profile means in each variable. 'SLC' is short for school-leaving certificates.

Source: Data set on 338 training occupations.

Figure 2 illustrates clear differences between the skill profiles in commitment, gratifications and social access based on school-leaving certificates: In comparison to the other profiles, the **OS-LC** profile is characterised by medium commitment, as production-oriented strategy is important for 21.3% training occupations and investment-oriented strategy is important for 92.0% training occupations. The OS-LC Profile offers comparatively lower gratifications (see Figure 2): Training allowances average €800 per month, which is close to the overall average of €814, while the occupational prestige (5.3) is slightly below the overall average of 5.5. The OS-LC skill profile exhibits the highest proportion of trainees with intermediate (42.2%) and lower school-leaving certificates (31.1%), both of which are well above the overall average. Consequently, the share of trainees with higher school-leaving certificate is below average in this skill profile (20.4% compared to the overall average of 32.5%).

The **OS-HC** Profile exhibits stronger training commitment, as more training occupations are trained from an investment-oriented strategy (94.6%), while the production-oriented strategy is least important in this profile (see Figure 2). The profile offers the highest gratifications among the skill profiles (see Figure 2): training allowances are above

average (€893 per month) and occupational prestige is high (6.2). The educational level of the trainees is considerably above the overall average: more than half have higher school-leaving certificate (53.2%), while trainees with lower school-leaving certificates are a minority (6.2%).

The **FS** Profile exhibits the highest average importance of the production-oriented strategy (important for 30.5% training occupations) and lowest average importance of the investment-oriented strategy (still 88.0%) (see [Figure 2](#)). We interpret this as a comparatively weaker training commitment. Training allowances (€811 per month) and occupational prestige scores (5.5) are around the average. Even though most trainees in this profile have an intermediate or higher school-leaving certificate (36.9% and 36.8%), 21.7% trainees have a lower school-leaving certificate.

The **HC** Profile is characterised by strong training commitment, as the production-oriented strategy is less important (only important for 15.8% training occupations) and this profile exhibits the highest importance of investment-oriented strategy among all skill profiles (important for 97.4% training occupations). With an average training allowance of €792 per month, monetary gratifications are the lowest in this profile (see [Figure 2](#)). Yet, the average occupational prestige (5.7) is higher than in the OS-LC and FS Profiles and ranges slightly above the overall average (5.5). Similar as in the OS-HC Profile, the majority of trainees possess higher school-leaving certificates (54.7%), while those with lower certificates are under-represented in this profile (8.4%).

A review of the training occupations clustered in the four skill profiles reveals significant differences in training commitment, gratifications and social access variables (see [Appendix A5](#)).

Concerning the training commitment, our results do not support the assumption that profiles with higher occupational specificity inherently display a greater tendency towards production strategy (H1a) (see [A5.1](#)). Instead, the findings indicate that the OS-HC has significantly lower importance of the production-oriented strategy than the FS Profile. Furthermore, our results do not support the assumption that skill profiles with higher firm specificity or higher cognitive requirements exhibit a stronger prevalence of the investment strategy than profiles with lower firm specificity or lower requirements (H1b). Although skill profiles with higher cognitive requirements show a greater tendency towards the investment strategy, these differences are not statistically significant (see [A5.1](#)). Nor do the profiles with higher firm specificity exhibit a greater prevalence of the investment strategy than those with lower firm specificity.

The analysis of gratifications (see [A5.2](#)) reveals significantly higher allowances in the OS-HC Profile: compared to the other skill profiles, trainees in the OS-HC Profile earn an average €80 to €100 more per month. Contrary to our expectations, skill profiles with higher occupational specificity, firm specificity or cognitive requirements are not inherently associated with higher allowances (H2a). Pairwise comparisons of non-monetary gratifications point to significantly lower occupational prestige in the OS-LC Profile compared to the smaller skill profiles (OS-HC, FS & HC). However, the OS-HC Profile exhibits significantly higher occupational prestige. This is in line with our assumption that skill profiles with higher cognitive requirements could be associated with higher occupational prestige (H2b).

Concerning social access based on school-leaving certificates, our results show clear differences in the shares of lower and higher school-leavers across all four profiles (see

A5.3). The smaller skill profiles OS-HC, FS and HC compose significantly higher shares of trainees with higher school-leaving certificates than the OS-LC Profile. Specifically, in the two profiles with higher cognitive requirements (OS-HC & HC), over 50% of trainees hold higher school-leaving certificates. Conversely, the three smaller skill profiles exhibit significantly lower shares of trainees with lower school-leaving certificates than the OS-LC Profile, which composes the highest share of trainees with lower certificates. The OS-LC Profile also exhibits significantly higher shares of trainees with intermediate certificates than the FS Profile. This is in line with our expectation that skill profiles with higher firm specificity or higher cognitive requirements should exhibit higher shares of trainees with higher school-leaving certificates (H3).

We conducted robustness checks by recalculating the latent profile analysis using a dual-training-only sample, which yielded a three-profile solution that reconstructs the FS, HC Profile and finds one OS Profile that clusters all occupations with higher occupational specificity and lower and higher cognitive requirements. Additionally, using average occupational net training costs as an alternative measure for training commitment confirmed the robustness of our results.

Discussion and conclusion

VET is not homogeneous but consists of very different educational programmes. Researchers investigating the stratification along these heterogeneous training occupations argue that the training system itself is internally segmented (Baethge 2010; Hall 2021; Protsch and Solga 2016). However, existing definitions of occupational training segments often are very broad categories distinguishing dual and school-based training or focusing on the typical educational composition of trainees. This paper takes a different approach. We develop a conceptual framework for the occupational segmentation of VET by applying labour market segmentation to VET. We define segments by differences in skill profiles, training commitment, gratification and social access based on school-leaving certificates across training occupations. In contrast to previous studies, we consider both dual and school-based occupations and our analyses are based on data at a detailed occupational level.

Our findings point to four skill profiles which are characterised by structural differences in occupational specificity, firm specificity and the cognitive requirement level. The clustering of these three skill dimensions reveals the structural similarities of the skill bundles of training occupations, regardless of their vocational differences. The results reveal some systematic associations of the four skill profiles with training commitments, gratifications and social access based on school-leaving certificates. The association of skill profiles with superior or inferior training conditions (higher vs. lower commitment or gratifications) lends support to the significance of the skill profiles. We thus conclude that the German VET system is divided into four distinct occupational training segments, which exhibit unequal training conditions in the sense that some segments offer significantly higher commitment or gratifications. In addition, we find distinct patterns of educational composition in the segments, which could indicate social selection processes based on educational credentials.

However, the conceptual framework is only partially confirmed; we do not find significant differences in the level of commitment across all segments. Whether this

is due to poor measurement or incorrect assumptions must be investigated in future studies. Importantly, the segments lie across institutional differences between dual and school-based training occupations supporting the argument that these institutional differentiations are not a substitute for occupational training segments.

Our study considers the majority of VET; however, it has to be noted that it is restricted to training occupations offered in 2019 and a necessary selection of school-based training occupations. Hence, newly established and currently no longer offered or extinct training occupations are not included. This would be an important further extension to our study, particularly for a comparative analysis of the segments over time. Further, subsequent research should investigate to which extent the segmentation of VET contributes to the observed differences between training occupations in the labour market. We assume that the observed differences in skill profiles, training commitment, gratifications and social selectivity based on school-leaving certificates in access to segments could be associated with different transition paths and labour market prospects. Ultimately, the meso-level segmentation approach and the concept of skill profiles may also provide a useful framework for international comparative research on the heterogeneity within and between VET systems.

This study might provide useful insights for political actors and institutions involved in VET as well as for firms and vocational schools offering training. First, for policy makers and institutions, education monitoring and reporting could be supplemented by segment-specific analyses, for example, on the training stability, transitions into training and labour market success by VET segments. Such analyses could provide a compact and informative approach to assessing the heterogeneity of VET and deriving recommendations for its improvement. Second, institutional actors involved in the regulation of training curricula could profit from insights about the importance of skill profiles for VET segmentation. Third, training firms and vocational schools offering training in low-demand training occupations could use the results to learn more about the attractiveness of their occupations and identify leverage for improvement to attract more applicants.

Notes

1. In 2019 the Register of Recognised Training Occupations enlisted 326 dual and 80 school-based training occupations. Our data encompass 317 dual-training occupations and the 21 largest school-based health and care occupations.
2. Some exceptions offered in both systems include housekeeping professions or beauticians.
3. Trainees without or other (mainly foreign) credentials are not analysed because of small case numbers.

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Disclosure statement

There are no known conflicting interests.

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